Senior Thesis

# The Ground-Water Potential of Two Proposed Well Sites in Northeastern Pickaway County, Ohio


by
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## ABSTRACT

The City of Columbus has purchased two potential well sites, one in southwestern Harrison Township along Big Walnut Creek, and the other further upstream in central Madison Township. The objective of my study is to characterize the hydrogeologic setting of each of these sites.

The analysis will be based on well logs of all domestic wells in the area, including those that had to be located in the field due to a drilling date after the 1960's, after the last ODNR map was constructed. The logs were used to construct four cross sections, two for each site, one on either side of each proposed site.

The well-log information was also used to construct a composite potentiometric-surface map. Bedrock topography maps were derived from other sources due the shallowness of the area wells.

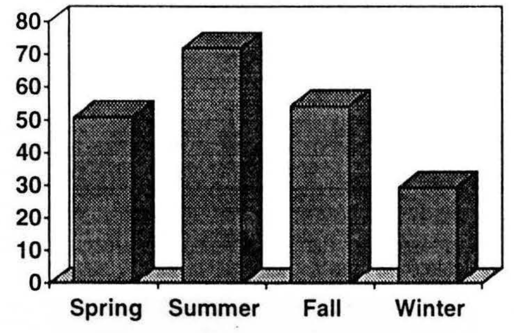
Geologic information was obtained from the area in order to understand the concepts of the buried valleys and what impact this would have on the hydrogeologic resources. Climatic data were also gathered in order to understand the amount of recharge that each area might receive.

## INTRODUCTION

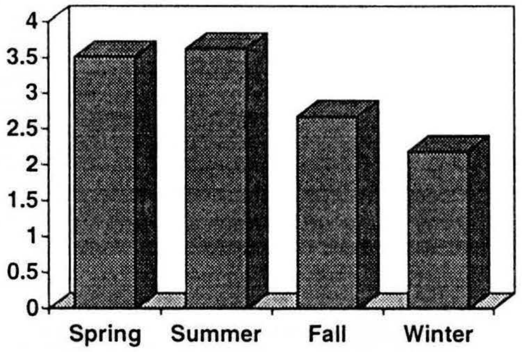
The sources of municipal water in Franklin County are no longer sufficient to keep up with the demand of its population. For this reason, Franklin County has looked to Pickaway County, in addition to other counties, for additional sources of water. Two potential well fields are being considered in northwestern Pickaway County for this purpose, the Madison Township well site and the Harrison Township well site (figure 1). The construction of wells at these potential sites and the use of this water in Franklin County are controversial. In effect, the residents of Pickaway County feel that their water supply is being "stolen". The purpose of this paper is to study the aquifer potential of these two well sites.

## CLIMATE

The following graphs portray the normal temperatures (Fahrenheit) and rainfall (inches) for Circleville, Ohio. Annually, Circleville has an average temperature of 51.5°F and an average rainfall of 37.99 inches. These data are the result of averaging the observed values from 1961 through 1990 (NOAA, 1961-1990).




**Temperature (Fahrenheit)**




**Rainfall (inches)**

## PLEISTOCENE GEOLOGY

Before the Pleistocene Epoch (2 mya), the Teays River originated in the Appalachian Mountains in northern North Carolina. It flowed northwest where it entered Ohio in south-central Scioto County and continued flowing northward through Pickaway County. It then took a sharp turn to the west just north of Asheville, Ohio. At this point the Teays River joined with the ancient Groveport River, and continued this course into Madison County. Then it flowed northwestward across western Ohio into Indiana, and eventually across eastern Illinois where it joined with an embayment of the Gulf of Mexico (figure 2). The Teays River was about 800 miles long and drained about two-thirds of Ohio (Hansen,1987).

It carved out a narrow and deep valley in Pickaway County, with valley depths below 550 feet above sea level in some areas. Depths of this valley varied due to the erosional character of the rocks in the area. For example, the Devonian Shale east of the present Scioto River is more resistant to erosion than the Silurian and Devonian carbonates of western Pickaway County (Bain, 1979).

Some geologists believe that the Teays River took a different course (Hansen, 1995). Instead of the Teays River taking a bend toward the west in Ohio, as described above, they believe that it continued northward, and eventually joined with the ancient Erigan River. This stream was once flowing in the same area that Lake Erie lies today (figure 2). They believe that the buried valley that runs in the westward direction was once a part of a meltwater stream that flowed along the ice front of an earlier glacier (Hansen, 1995). Unfortunately, the erosive nature of later glaciers and meltwater have buried any decent evidence that would prove or disprove either theory.

During the Pleistocene Epoch, there were several periods of glaciation and interglaciation that affected most of Ohio (figure 3). The Nebraskan glaciation that covered most of Ohio between 2 million to 690,000 years ago is thought to have dammed up the Teays River, causing many lakes to form in the southern part of the state. Evidence for the age of the damming comes from studies done on the magnetic polarity of a clay, known as the Minford clay, or Minford silt, deposited in these lakes. It was found that there was a reversed magnetic pole at this time, known as the Matuyama Reversed Epoch. The magnetic poles returned to their normal state about 690,000 years ago. Because of this, the clay had to have been deposited between 2 mya and 690,000 ya (Hansen, 1987). The Minford clay is the thickest in southern and southeastern Ohio, where thicknesses reach up to 900 feet in an area that once was covered by a large lake, Lake Tight (Hansen, 1987). This is only one of the many lakes that formed as a result of the damming of the Teays River. In Pickaway County, the maximum thickness of this clay is unknown due to the erosion that came as a result of the following periods of glaciation (Bain, 1979).

While this ice sheet was retreating, the meltways cut the Deep Stage channel, which is approximately parallel to the present course of the Scioto River. These meltwaters cut a valley deeper into the bedrock than did the Teas River, hence the name "Deep Stage". The drainage of this valley was opposite that of the Teays River and flowed from north to south. This channel became filled with sand and gravel, forming the thick sand and gravel aquifer found in the buried valley in central Pickaway County. This sand and gravel filled the Deep Stage channel, including the lower parts of the Teays River channel in some areas. This resulted in a sand and gravel aquifer that reaches elevations of 550 to 600 feet (Bain, 1979). At this time, in the southern portion of Ohio, the modern drainage system of the Ohio River was formed.

Above this aquifer is a thick clay layer, resulting from the Wisconsinan and Illinoian glacial events during the Pleistocene Epoch. This thick clay is found in northern Pickaway County, indicating that there was a minor readvancement of the glaciers (Bain, 1979). This thick clay layer forms a poorly permeable layer above the sand and gravel aquifer.

After Pleistocene glaciation, the Scioto River formed its present course at an elevation of 600 to 660 feet above sea level. The Scioto River begins in west-central Ohio, in Hardin County, and continues east to Marion County. It then continues south through Franklin and Pickaway Counties and eventually drains into the Ohio River in southern Scioto County.

## BEDROCK AQUIFER POTENTIAL

The bedrock at both potential well fields is shale of Devonian to Mississippian age. The shale is poorly permeable and has a well yield is similar to clay. Well yields do not exceed 2 gpm in most areas, and the shale is generally stated to be a poor source of ground water (ODNR, 1958). Most water that is available from this bedrock is in the uppermost 10 to 50 feet due to fractures in the shale as a result of weathering. Here, ground water may flow due to the fractures but at a greater depth permeability will decrease because fewer fractures are present. Ground water may be able to be stored in the shale but water will not flow readily (Division of Water, 1960). Leakage in the shale may occur from the overlying aquifer or from the carbonate sequence below (Allong, 1971).

Based on well logs (table 1) and other outside sources, I constructed two cross sections for each potential well field (Plates I-IV). Bedrock relief is as much as 20 feet at the Harrison Township well site (Plates I and II) and as much as 50 feet at the Madison Township well site (Plates III and IV). The large amount of relief found at the Madison Township well site is due to its proximity to the buried valley system. Bedrock relief in the area on a larger scale around the proposed well sites was modified from Bain (1979) in figures 4 and 5.

## GLACIAL AQUIFER POTENTIAL

### Outwash

Sand and gravel that was deposited within channels as a part of the drainage system for glacier meltwaters and the course of these rivers was determined, in part, by the glacial ice fronts. The valleys cut by the Teays River and the Deep Stage drainage system were filled mostly with sand and gravel. Commonly, these deposits exceed 100 feet in thickness and have been found to be as thick as 300 feet. The sand and gravel aquifer in the proposed well site areas was deposited by meltwater streams such as during the development of the Deep Stage drainage system. It is sometimes seen to be interfingered with clay lenses. Domestic well logs of the area show (Table 1) many clay lenses in the area of the proposed well sites (Plates I-IV).

In Pickaway County, where the sand and gravel aquifers are shallow enough and occasionally exposed, "water is stored under water-table conditions" and some water may be stored above the water table (Allong, 1971). In the buried deposits, though, confined aquifer conditions occur.

Data from the London Fish Hatchery in Madison County (transmissivity and storage coefficients) indicate that the permeability of lens-like deposits are less than that of the channel-fill deposits. This is also true at the London Prison Farm, and at New Vienna, in Clinton County (Allong, 1971).

Flow throughout the Scioto River valley is towards the Scioto River regionally, with Walnut Creek intercepting some of the ground-water flow. Locally, flow moves towards the buried valleys, and then downgradient along these deposits, which have greater permeability.

Based on historic well-log information, the local hydraulic gradient at the Madison Township well site is between 0.0018 - 0.0053 towards Walnut Creek and at the Harrison Township well site it is about 0.0055 towards Walnut Creek. At the latter site there is a local potentiometric high, with the southeast side draining towards Walnut Creek and the northwest side draining into the Scioto River (figures 6 and 7).

Recharge in the area is mainly due to precipitation, runoff, flooding, and leakage across confining layers. Precipitation is a good source of recharge mainly in the spring when evapotranspiration is low and storms yield large amounts of precipitation. Runoff from the higher edges of the valley also is a source of recharge of the streams. Flooding causes water to be added to the sand and gravel aquifers that are present at the earth's surface. Leakage is a reliable source of recharge, allowing surface water to penetrate the deeper aquifers and provide water to the deeper wells. Locally, the bedrock is shale, and water is not leaked through the bedrock very well. This serves as a boundary surface for the buried valley aquifers.

The direction of ground-water flow can be greatly affected by pumping. There are only domestic wells in the area of study, so ground-water flow is basically normal, flowing towards the Scioto River and Walnut Creek. However, with the addition of the municipal wells that are to be drilled in these study areas, the potentiometric surface and, therefore, the ground-water flow, will be changed dramatically, and could cause the stream to recharge the aquifer in the areas of these wells (figure 8). This could enable very high production rates along the Scioto River and Walnut Creek in properly constructed wells. However, an increase in the pumping rates and a change in the local potentiometric surface may lead to the local dewatering of some domestic wells.

The proposed municipal wells should be large in diameter and be at a depth of about 75-135 feet (ODNR map, 1991). In this area, well yields can reach as high as 1000 gpm. These rates could be reached in both of the proposed well sites, due to their proximity to Walnut Creek. By constructing the wells with a different design from that mentioned above, the aquifer would support a pumping rate of 100 to 500 gpm (ODNR map, 1991).

Recharge from the river to the municipal wells would yield a quality of water that is similar to that of the stream. However, at the same time, conditions may improve due to an increase in the rate of water circulation (Allong, 1971).

## Till

Till is a mode of transport that in this area yielded deposits of thick clay along with some sand and gravel. It is a very poor aquifer due to the low permeability of the clay, and also to the varying grain sizes. This clay includes in some areas the Minford clay that was mentioned earlier. The till was found to have a possible yield of 5 gpm or less (ODNR map, 1960), with the permeability increasing slightly with increasing sand and gravel content (Allong, 1971).

The water table in the till tends to follow the topography in northeastern Pickaway County at a depth of about 5 to 10 feet (Bain, 1979). Local sand lenses may give the impression that the water table is higher, when in fact, it is only due to the water being under pressure from the confined aquifer caused by overlying clay or other semi-permeable surface.

According to Bain (1979), hydrograph studies done by Henning (1978) showed that the recharge rates into the streams Deer Creek, Mt. Sterling, and Darby Creek, in northwestern Pickaway County, were basically the same, with small amounts of variation due to possibly different composition of till, different thicknesses of the till, and variances in the streams, such as grade. Henning (1978) grouped his studies according to amount of precipitation, due to the fact that recharge of the till is directly related to the amount of precipitation of the area.

Discharge is mainly due to evapotranspiration (Allong, 1971). According to Allong (1971), a discharge rate of 1.24 mgd/sq. mile was estimated by Norris (1969). There is also a significant amount of runoff into the local streams because the till is so low in permeability (Allong, 1971). No wells in the area of study were found to be pumping from the water table, but instead from the confined sand and gravel aquifer (ODNR well logs, table 1).

## CONCLUSIONS

The City of Columbus has purchased land in northeastern Pickaway County that may be used for future municipal wells. The Harrison Township well site and the Madison Township well site are located on the edge of the buried valley system of south-central Ohio. As a result, the amount of water available may be sufficient for the city's plans for the wells. Local aquifer conditions are good for the construction of large wells. The sand and gravel aquifer is often found to be between 100 and 300 feet in thickness, with some large clay lenses that cause confining layer conditions.

By pumping the wells at a high rate, the wells may draw water from the Scioto River and Walnut Creek, causing a discharge area to convert to a local recharge area. Although this allows for an increase in the amount of water available, it could lead to local dewatering of domestic wells.

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Schmidt, James J. and Goldthwait, Richard P., 1958, The Ground Water Resources of Franklin County, Ohio, Bulletin 30: Ohio Department of Natural Resources, Division of Water, Figure 8, Table 2.

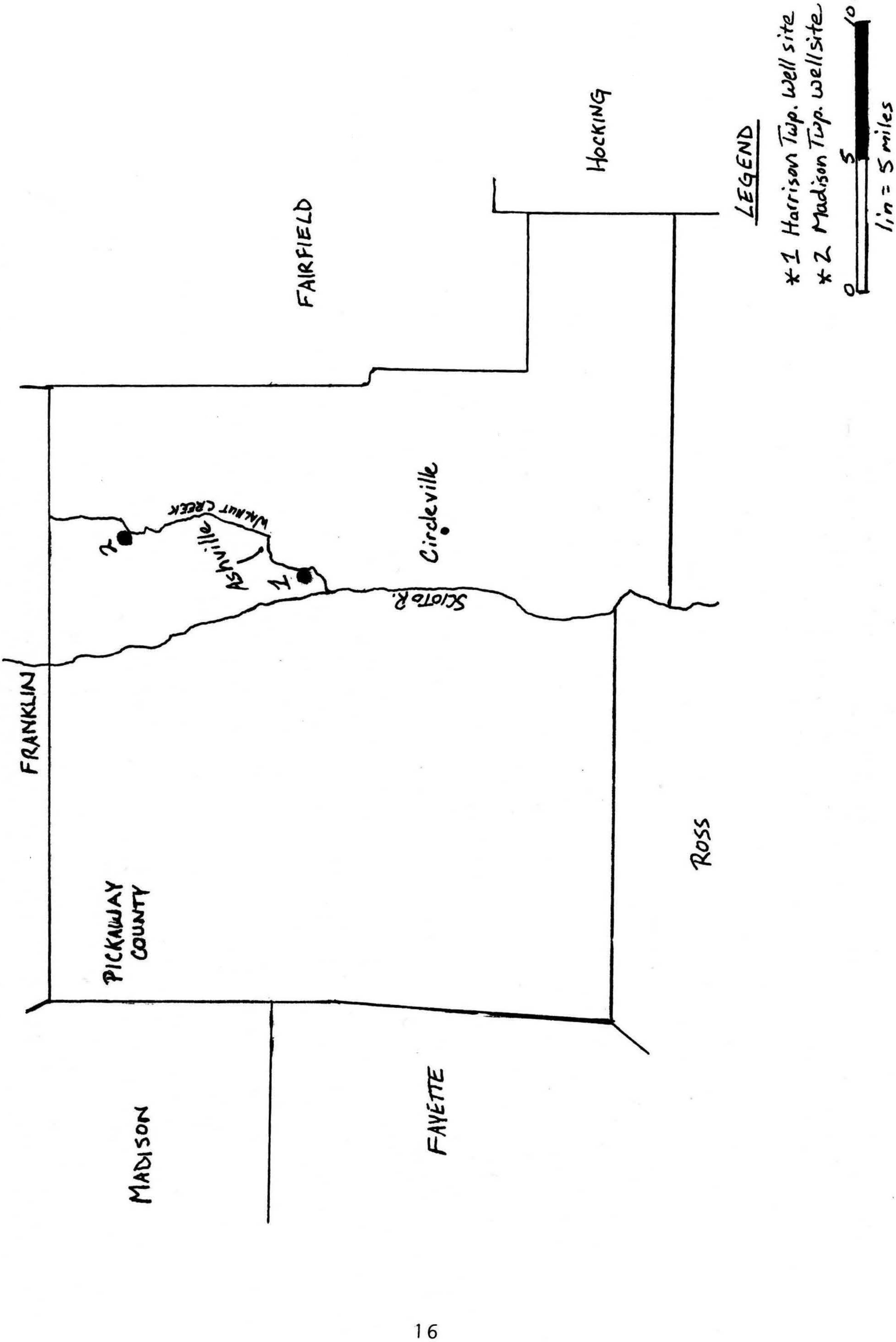
______, 1960, Underground water resource map: M-4 --Big Walnut Creek Basin: Ohio Department of Natural Resources, Div. of Water, Ohio Water Plan Inventory, map.

______, 1961, Underground water resource map: M-8 --Scioto River Basin (Middle portion): Ohio Department of Natural Resources, Div. of Water, Ohio Water Plan Inventory, map.

______, 1978, Underground water resource map: M-9 --Walnut Creek Basin: Ohio Department of Natural Resources, Div. of Water, Ohio Water Plan Inventory, map.

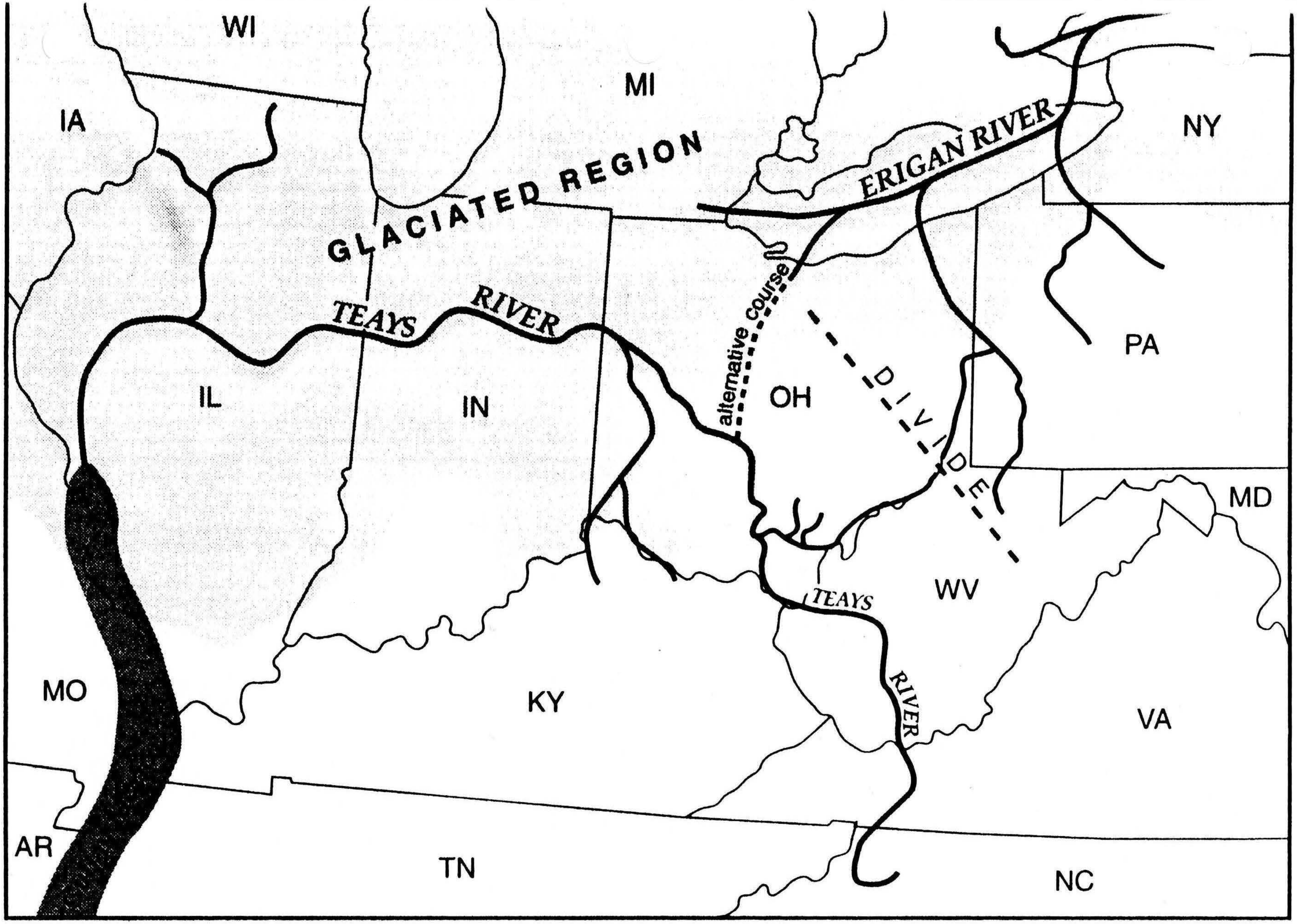
______, Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1961-1990: Climatography of the United States No.81, National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data, and Information Service, National Climatic Data Center Asheville, N.C.

FIGURE 1



LEGEND
*1 Harrison Twp. Well site
*2 Madison Twp. wellsite
0
5
10 miles
1 in = 5 miles
HOCKING
FAIRFIELD
Circleville
WALNUT CREEK
Ashville
1
2
SCIOTO R.
FRANKLIN
PICKAWAY COUNTY
ROSS
FAYETTE
MADISON

FIGURE 2




*Classic interpretation of the preglacial Teays River and an alternative course (dashed line) favored by some geologists. The entire extent of the Teays and its tributaries north of the glacial border is buried beneath thick glacial drift. Northern Ohio was drained by the Erigan River, which followed the axis of what is now Lake Erie, and flowed into the ancestral St. Lawrence River. Neither the Great Lakes nor the Ohio River existed at this time.*

FIGURE 3

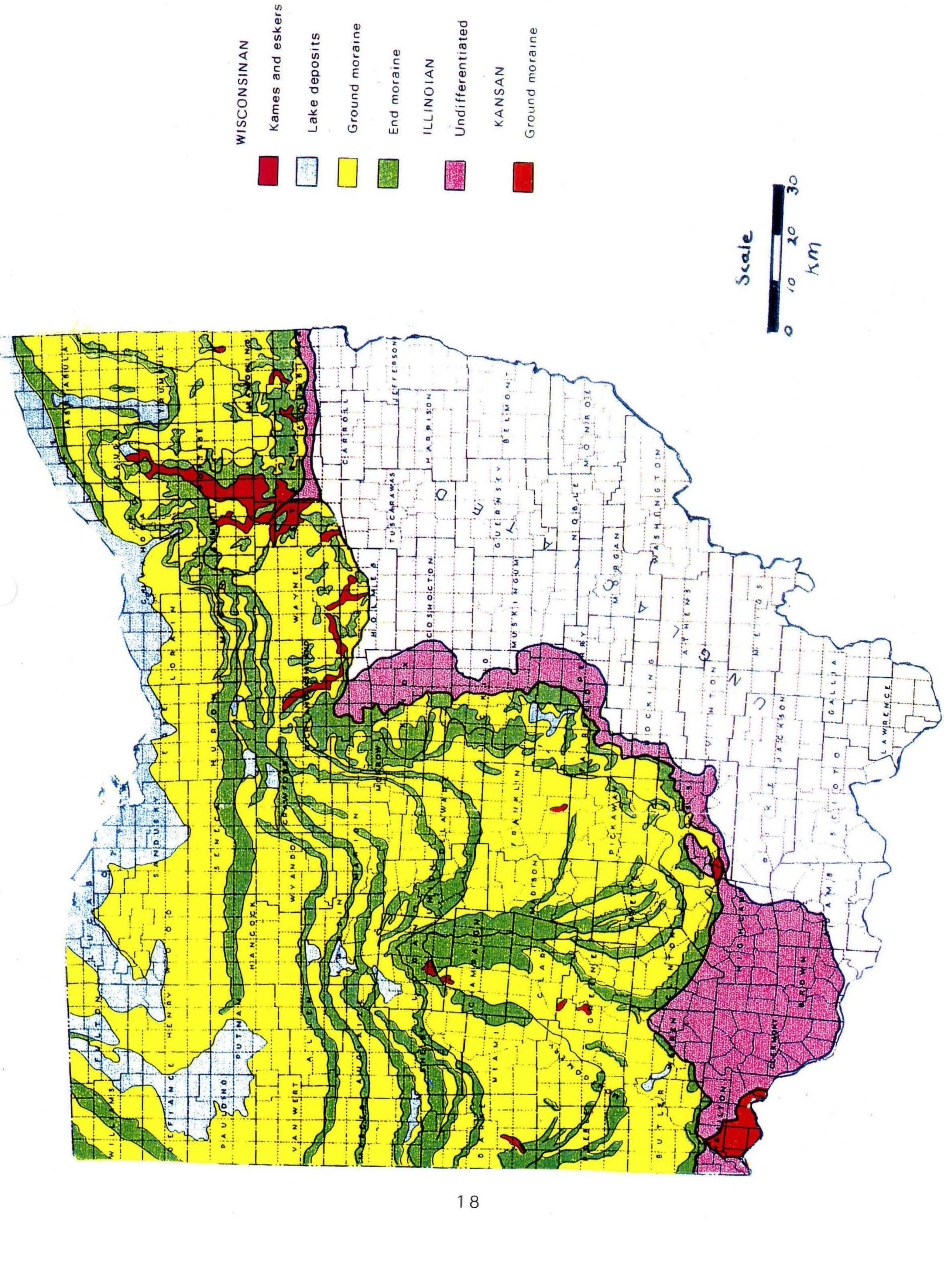
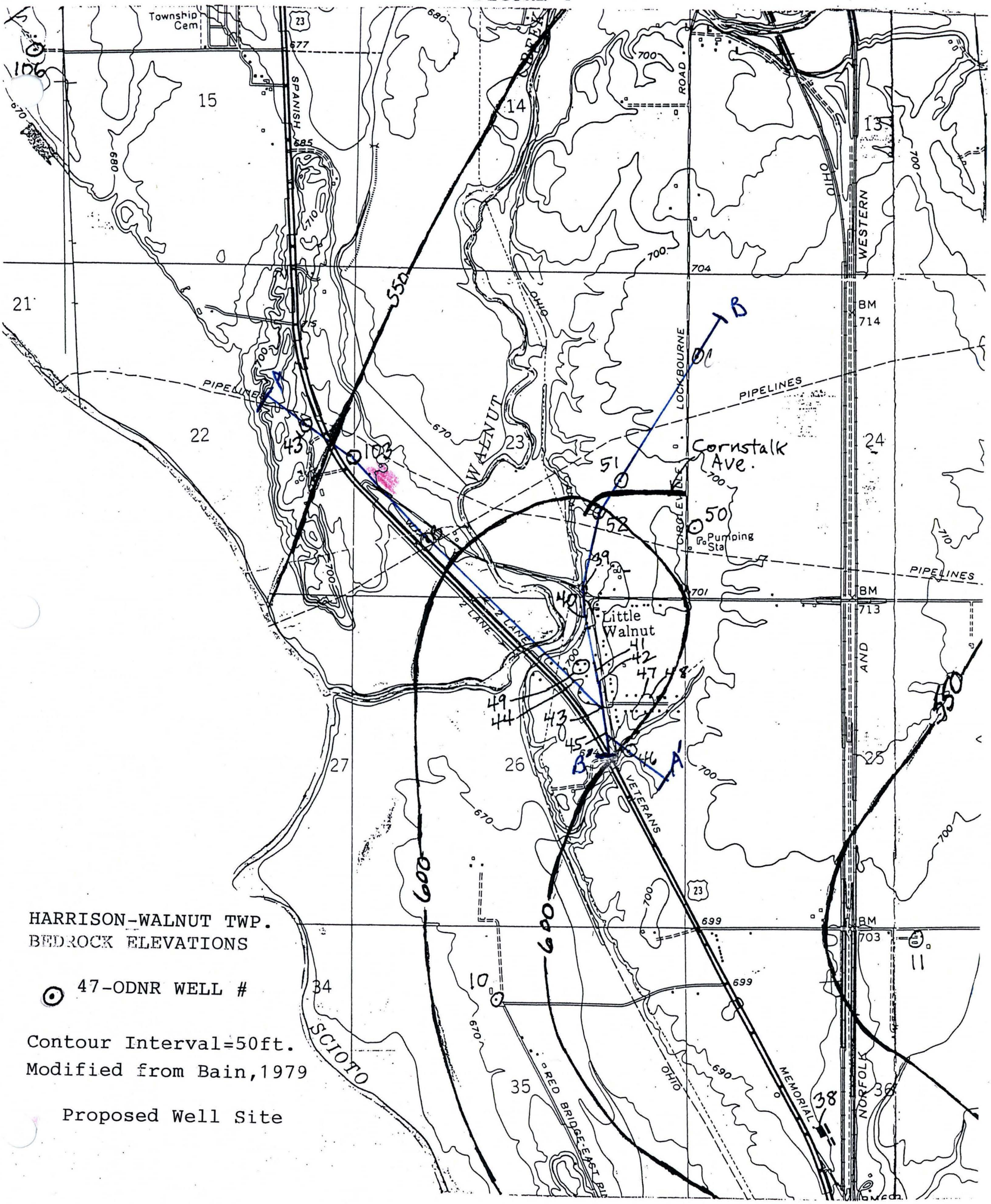

WISCONSINAN
Kames and eskers
Lake deposits
Ground moraine
End moraine
ILLINOIAN
Undifferentiated
KANSAN
Ground moraine
Scale
0 10 20 30
km

FIGURE 4




HARRISON-WALNUT TWP.
BEDROCK ELEVATIONS

47-ODNR WELL #

Contour Interval=50ft.
Modified from Bain,1979

Proposed Well Site

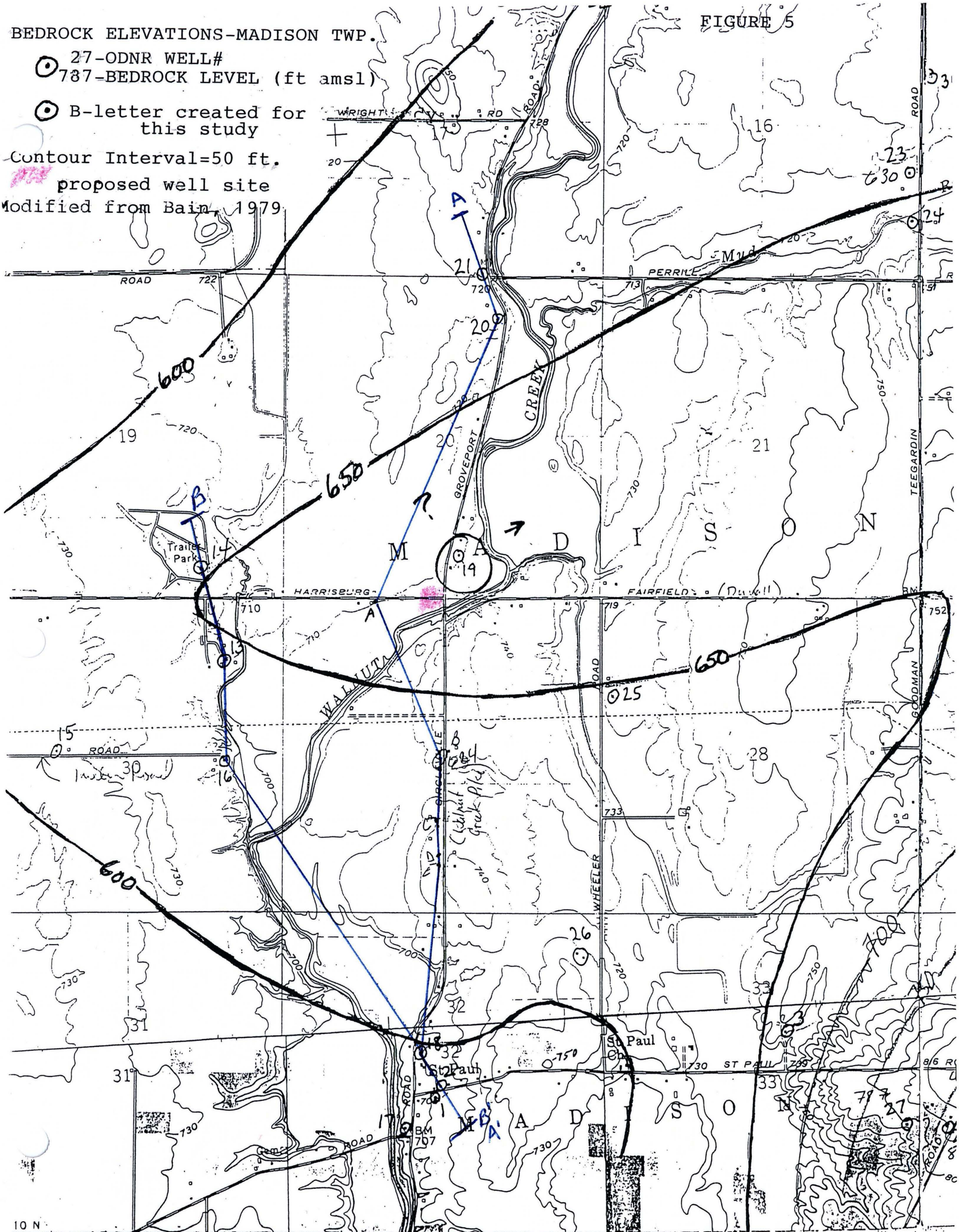
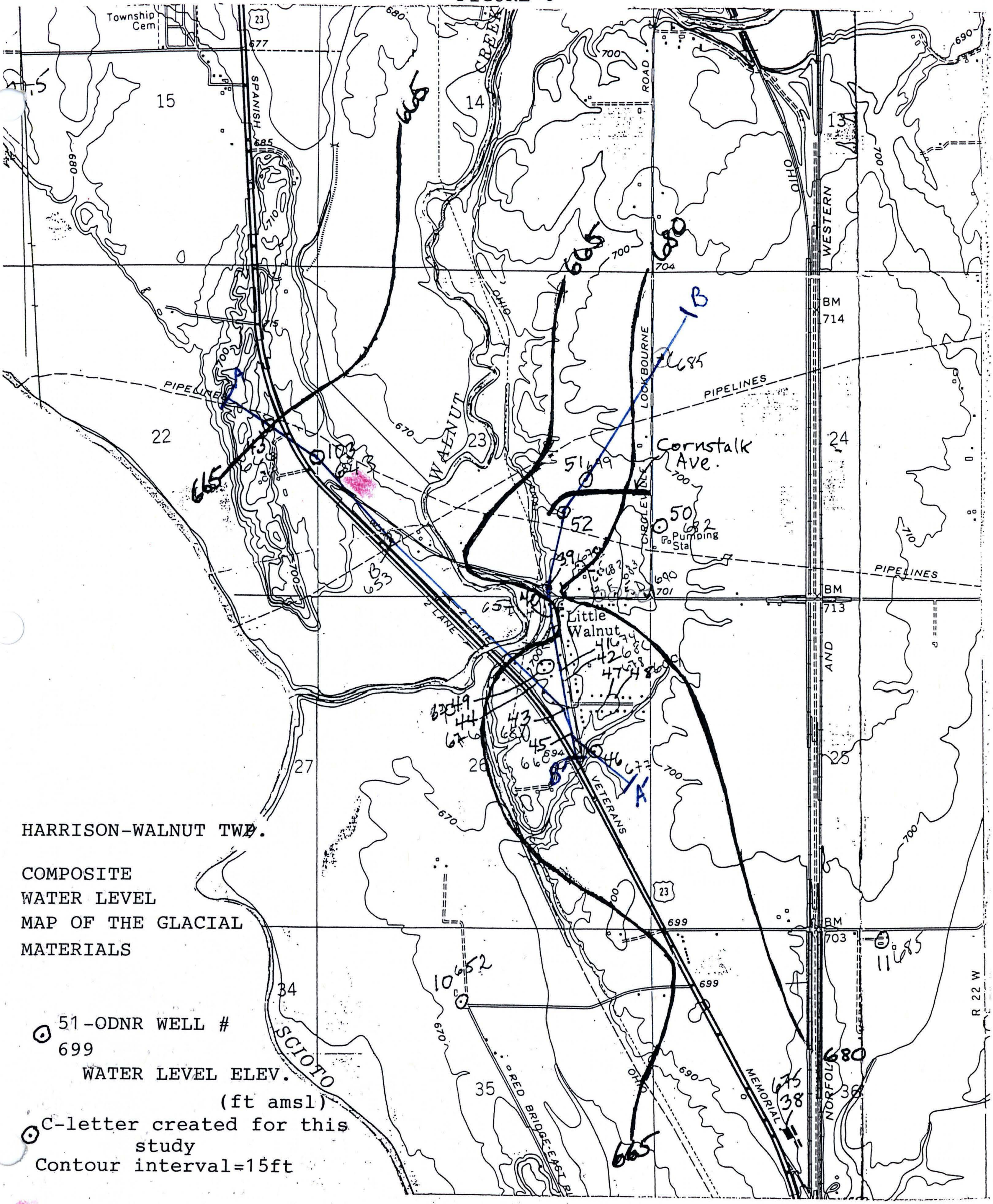


FIGURE 5
BEDROCK ELEVATIONS-MADISON TWP.
27-ODNR WELL#
787-BEDROCK LEVEL (ft amsl)
B-letter created for this study
Contour Interval=50 ft.
proposed well site
Modified from Bain, 1979
600
650
700
WRIGHT RD
PERRILL ROAD
HARRISBURG
FAIRFIELD
GROVEPORT ROAD
TEEGARDIN ROAD
GOODMAN
WHEELER ROAD
WALNUT
CREEK
ST PAUL
St Paul Ch
Trailer Park
M A D I S O N
A
A'
B
B'
10 N

FIGURE 6




HARRISON-WALNUT TWP.

COMPOSITE
WATER LEVEL
MAP OF THE GLACIAL
MATERIALS

51-ODNR WELL #
699
WATER LEVEL ELEV.
(ft amsl)
C-letter created for this study
Contour interval=15ft

proposed well site

COMPOSITE WATER LEVEL MAP OF THE GLACIAL MATERIAL MADISON TWP.

FIGURE 7

19-ODNR WELL #
700-WATER LEVEL ELEVATION (ft amsl)
A-letter created for this study
Contour interval=50 ft.
proposed well site

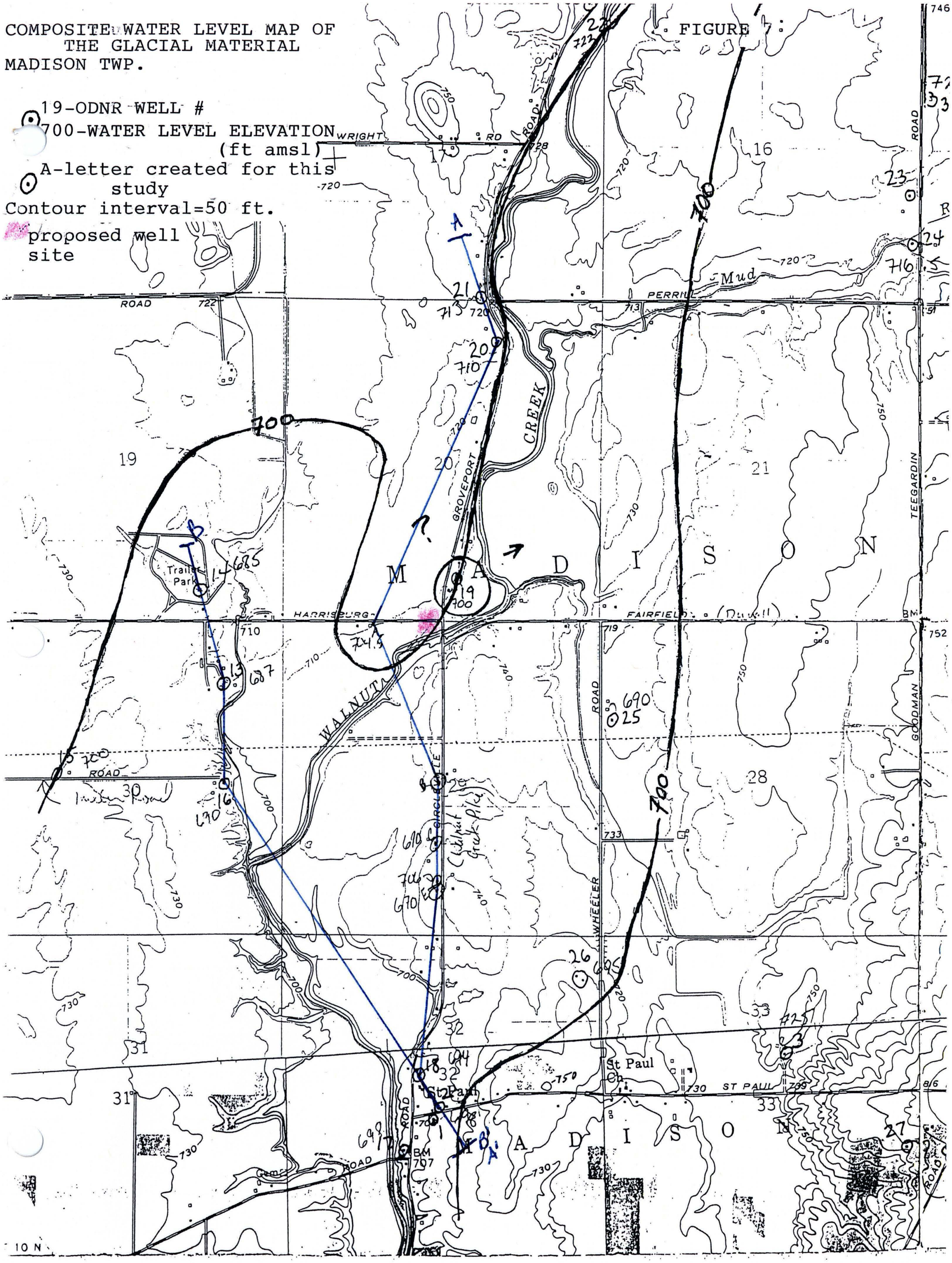


FIGURE 8

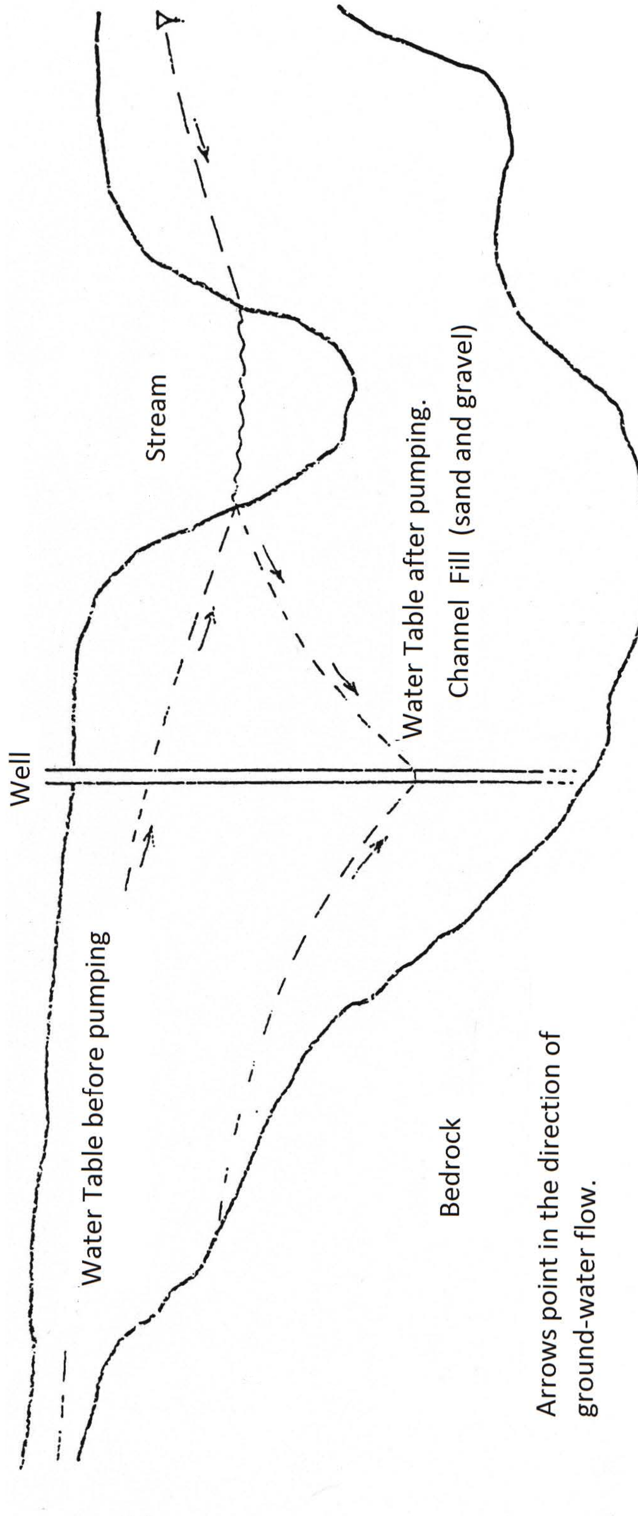



Figure 11. Schemetic Diagram showing Induced Recharge

Table 1

| Well # * | Well log # (ODNR) | Owner | Driller | Q/s (gpm/ft) | depth to water (ft) |
|---|---|---|---|---|---|
| Harrison Twp. | | | | | |
| B | 627879 | Porter | Gobel? | 20/none | 27 |
| 43 | 381265 | State Hwy Patrol | Gobel's Well Drilling | 20/1 | 24 |
| 103 | 298147 | R. List | P. Wright | 10/2 | 37 |
| 106 | 138943 | J. Dowler | Short Bros. | 5/yes | 17.5 |
| | | | | | |
| Madison Twp. | | | | | |
| A | 705186 | S. Edgar | Short Bros | 7/.25 | 5.5 |
| B | 779494 | M. Cline | R. C. Barry Inc | 10/none | 21 |
| C | 720225 | L. Cline | Spung's | 10/20 | 40 |
| D | 801196 | Cline Bldrs | R. C. Barry | 15/ | 29 |
| E | 758271 | Roberts | Prof. water well systen | 15/10 | 70 |
| 2 | 309172 | Hicks | Short Bros. | 10/none | 12 |
| 3 | 454541 | Kennedy | C+P well drilling | 3/ | 15 |
| 10 | 253691 | Stir | Short Bros. | 10/all | 1 |
| 12 | 355520 | Teegardin | Joe Christz | .5/total | 8 |
| 13 | 328252 | Crites | Joe Christz | 12/1 | 33 |
| 19 | 462218 | Wheeler | Short Bros. | 8/3 | 10 |
| 20 | 462210 | White | Short Bros. | 15/2 | 10 |
| 21 | 462211 | White | Short Bros. | 15/8 | 17 |
| 22 | 400179 | Karennich | Short Bros. | 15/2 | 8 |
| 23 | 301741 | Lurue | Short Bros. | 10/yes | 20 |
| 24 | 207026 | Lurue | Short Bros. | 30/10 | 3.5 |
| 25 | 265238 | Ashmon | Short Bros. | 10/3 | 30 |
| 26 | 354773 | Purill | Short Bros. | 12/25 | 35 |
| 27 | 369624 | Solt | J. Christz | 20gph/total | c.18 |
| 28 | 265245 | Dixon | Short Bros. | 10/all | 11 |
| 29 | 253683 | Roger | Short Bros. | 12/all | 4 |
| 35 | 179893 | Zwayer | Short Bros. | 60/? | 34 |
| 36 | 301742 | Zwayer | Short Bros. | 10/none | 20 |
| | | | | | |
| Walnut Twp. | | | | | |
| A | 627878 | Rieghel | Gobel? | 20/none | |
| C | 677818 | Thomas | Smith's Well Drilling | 25/10 | 15 |
| D | 714470 | Sturdy Bld | C&P Well Drilling | 15/none | 10 |
| E | 785285 | Sturdy Bld | C&P Well Drilling | 15/none | 17 |
| F | 785293 | Crum | C&P Well Drilling | 15/none | 18 |
| G | 792960 | Cline Blds | R.C. Barry, Inc | 10+/ | 15 |
| 10 | 236431 | Wellms | Joe Cristz | 15/1.5 | 18 |
| 11 | 223505 | Dawern | Grant Thomas | 15/none | 12 |
| 31 | 233050 | Cummins | Short Bros. | 20/yes | 35 |
| 32 | 423656 | Stewart | Sam Lewis | 16/none | 40 |
| 36 | 421417 | Nothstein | Christz | 20/4 | 30 |
| 37 | 240175 | Noecker | Burl Gillum | 32/35 | 25 |
| 38 | 386784 | 84 Lumber | R. Lewis | 10/none | 15 |
| 39 | 439545 | Lemaster | C&P Well Drilling | 18/none | 11 |
| 40 | 267712 | Marshall | D. L. Whitesed | /28 | 23 |

* The numerical designations were assigned by ODNR, the alphabetical designations were created for this study.

Table 1

| Well # * | Well log # (ODNR) | Owner | Driller | Q/s (gpm/ft) | depth to water (ft) |
|---|---|---|---|---|---|
| 41 | 216056 | Toole | Joe Christz | 16/3 | 26 |
| 42 | 364523 | Frazier | Gobel's Well Drlg | 20/5 | 20 |
| 43 | 187490 | Hankins | Harley Noggle | 10/4 | 19 |
| 44 | 265169 | Heslop | D. L. Whitesed | /28 | 24 |
| 45 | 467666 | Hooner | Joe Christz | 25/3 | 30 |
| 46 | 314512 | Hills | D. L. Whitesed | 24/22 | 13 |
| 47 | 224670 | Hoffhines | Short Bros. | 8/2 | 22 |
| 48 | 187494 | Thomas | Harley Noggle | 12/6 | 41 |
| 49 | 454535 | Dean | C&P Well Drilling | 10/ | 32 |
| 49 | 236435 | Dean | Joe Cristz | 12/2 | 30 |
| 50 | 429520 | Faunaugh | R. Lewis | 16/none | 18 |
| 51 | 505406 | Hahler | Merle Wright | 12/3 | 26 |
| 52 | 499159 | Blanton | C&P Well Drilling | 15/ | |
| 54 | 224667 | Hallenback | Short Bros. | 10/none | 22 |
| 57 | 347482 | Pettibone | A F. Ryan Well Drlg | 10/none | 8 |

* The numerical designations were assigned by ODNR, the alphabetical designations were created for this study.

Table 1

| Well # | depth to bedrock | | surface elevation (ft): | | | depth well | date |
|---|---|---|---|---|---|---|---|
| | (ft) | | land | water level | bedrock | (ft) | |
| | | | | | | | |
| Harrison Twp. | | | | | | | |
| B | | | 680 | 653 | | 36 | Sep-85 |
| 43 | | | 690 | 666 | | 46 | Aug-68 |
| 103 | | | 680 | 643 | | 70 | Sep-63 |
| 106 | | | 690 | 672.5 | | 32.5 | Dec-54 |
| | | | | | | | |
| Madison Twp. | | | | | | | |
| A | | | 710 | 704.5 | | 17 | Apr-90 |
| B | 106 | | 730 | 709 | 624 | 108 | Oct-93 |
| C | | | 730 | 690 | | 102 | Nov-91 |
| D | | | 735 | 706 | | 111 | Oct-94 |
| E | | | 740 | 670 | | 120 | Sep-92 |
| 2 | | | 660 | 648 | | 40 | Mar-64 |
| 3 | | | 740 | 725 | | 118 | Jun-74 |
| 10 | | | 820 | 819 | | 37 | Apr-61 |
| 12 | | | 780 | 772 | | 195 | Jan-67 |
| 13 | | | 720 | 687 | | 56 | Feb-65 |
| 19 | | | 710 | 700 | | 21 | Nov-73 |
| 20 | | | 720 | 710 | | 70 | Oct-73 |
| 21 | | | 730 | 713 | | 76 | Oct-73 |
| 22 | | | 730 | 722 | | 59 | Dec-69 |
| 23 | 100 | | 730 | 710 | 630 | 100 | Nov-63 |
| 24 | | | 720 | 716.5 | | 50 | Apr-58 |
| 25 | | | 720 | 690 | | 73 | Jul-62 |
| 26 | | | 730 | 695 | | 75 | Oct-66 |
| 27 | 8 | | 795 | 777 | 787 | 132 | Dec-67 |
| 28 | 9 | | 810 | 799 | 801 | 82 | Jul-62 |
| 29 | 7 | | 820 | 816 | 813 | 55 | Feb-61 |
| 35 | 38 | | 760 | | 722 | 90 | Nov-56 |
| 36 | | | 740 | 720 | | 45 | Nov-63 |
| | | | | | | | |
| Walnut Twp. | | | | | | | |
| A | | | 710 | | | 35 | Sep-85 |
| C | | | 700 | 685 | | 63 | Mar-88 |
| D | | | 700 | 690 | | 46 | Jan-91 |
| E | | | 700 | 683 | | 46 | Jul-94 |
| F | | | 700 | 682 | | 43 | Sep-94 |
| G | | | 700 | 685 | | 47 | Jun-94 |
| 10 | | | 670 | 652 | | 38 | May-60 |
| 11 | | | 700 | 688 | | 57 | Jan-60 |
| 31 | | | 720 | 685 | | 100 | Oct-59 |
| 32 | | | 710 | 670 | | 96 | Aug-71 |
| 36 | | | 710 | 680 | | 66 | Jun-71 |
| 37 | | | 710 | 685 | | 80 | Jan-60 |
| 38 | | | 690 | 675 | | 41 | Apr-70 |
| 39 | | | 690 | 679 | | 44 | Mar-73 |
| 40 | | | 680 | 657 | | 44 | Oct-61 |

* The numerical designations were assigned by ODNR, the alphabetical designations were created for this study.

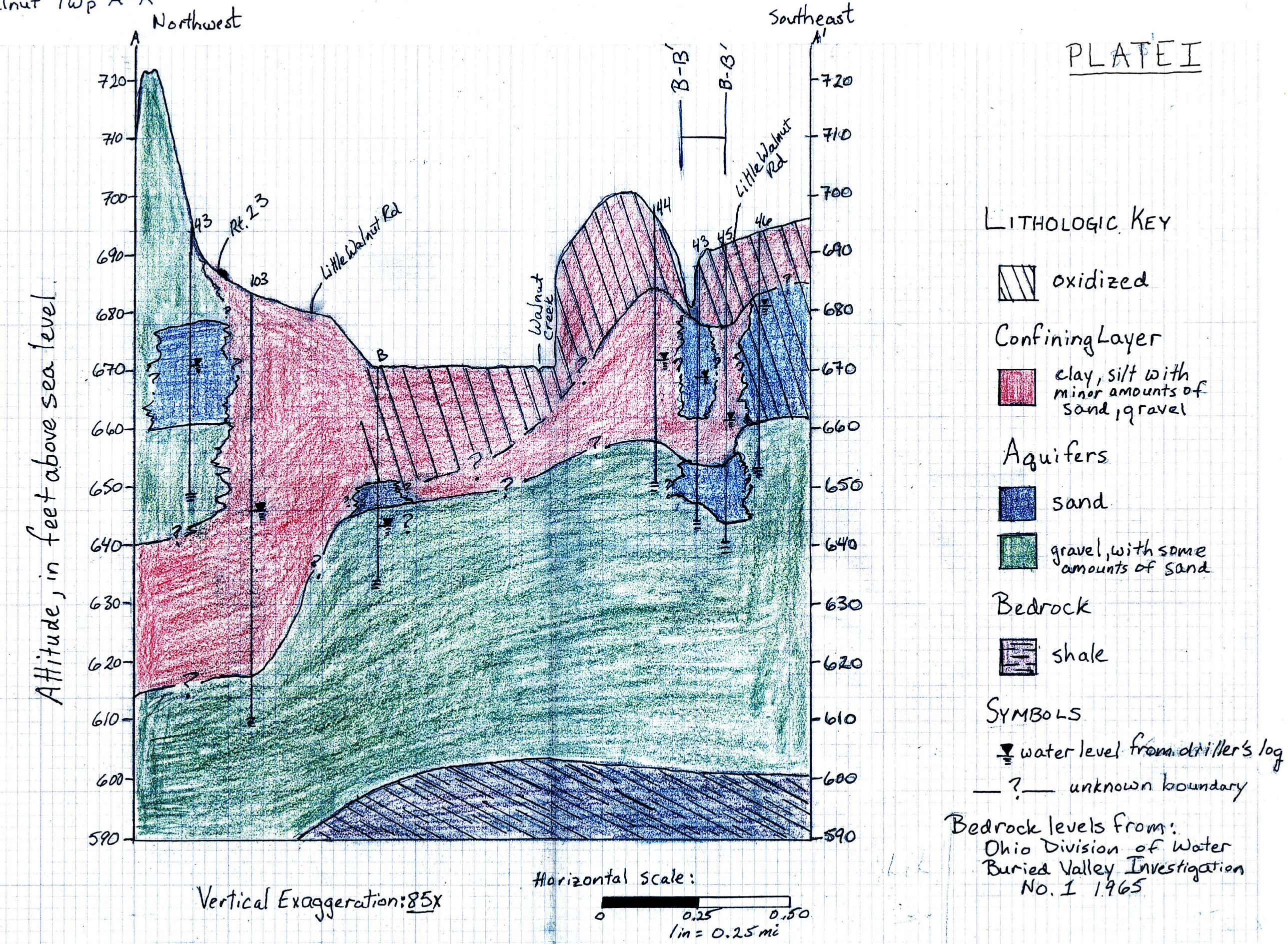
Table 1

| Well # | depth to bedrock | | surface elevation (ft): | | | depth well | date |
|---|---|---|---|---|---|---|---|
| | (ft) | | land | water level | bedrock | (ft) | |
| | | | | | | | |
| 41 | | | 700 | 674 | | 45 | Jun-58 |
| 42 | | | 700 | 680 | | 39 | Aug-67 |
| 43 | | | 700 | 681 | | 40 | Mar-59 |
| 44 | | | 700 | 676 | | 45.5 | Jun-61 |
| 45 | | | 690 | 660 | | 51 | Jul-74 |
| 46 | | | 690 | 677 | | 40 | Jun-65 |
| 47 | | | 700 | 678 | | 44 | Oct-58 |
| 48 | | | 710 | 669 | | 104 | Jun-59 |
| 49 | | | 700 | 668 | | 52 | Apr-74 |
| 49 | | | 700 | 670 | | 45 | May-60 |
| 50 | | | 700 | 682 | | 53 | Dec-71 |
| 51 | | | 695 | 669 | | 62 | Oct-76 |
| 52 | | | 690 | | | 66 | Jan-77 |
| 54 | | | 710 | 688 | | 44 | Oct-58 |
| 57 | | | 690 | 682 | | 39 | Jun-67 |

* The numerical designations were assigned by ODNR, the alphabetical designations were created for this study.

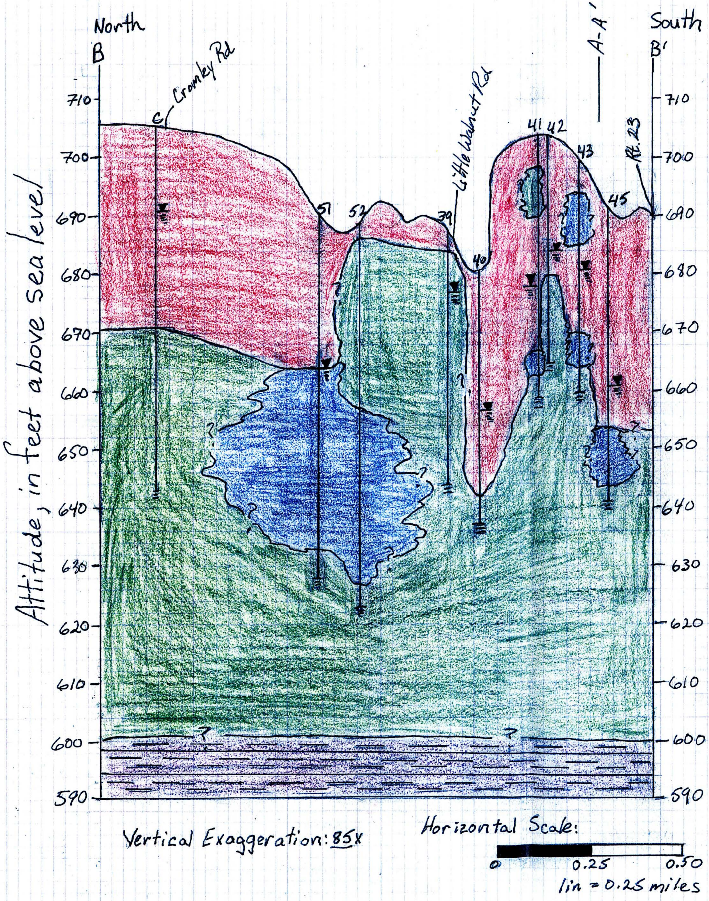
# PLATE I

Harrison-Walnut Twp A-A'



WALNUT TWP. B-B'

# PLATE II




**LITHOLOGIC KEY**

oxidized

Confining Layers

clay, silt with small amount sand, gravel

Aquifers

sand

sand and gravel

Bedrock

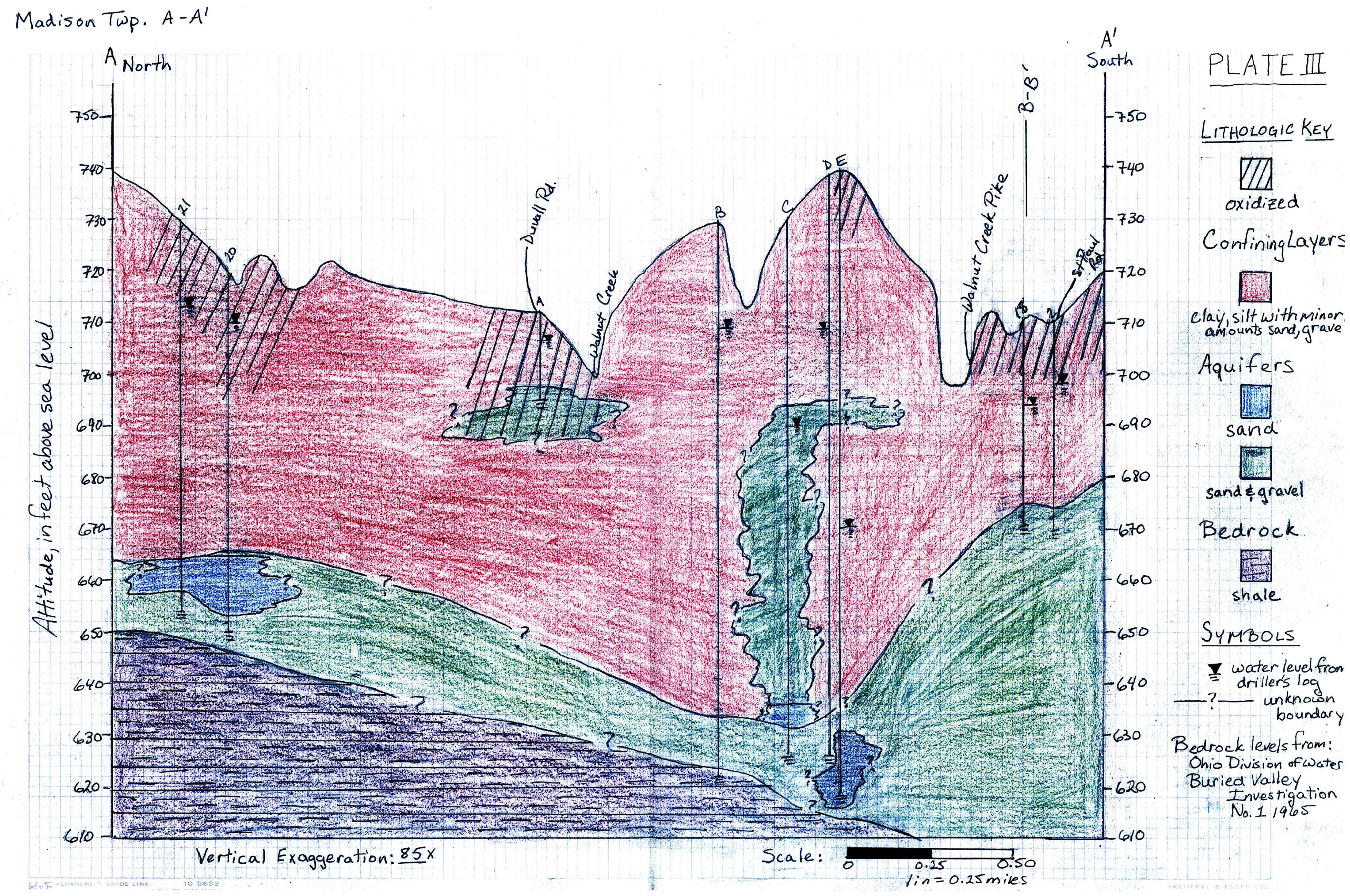
shale

**SYMBOLS**

water level from driller's log

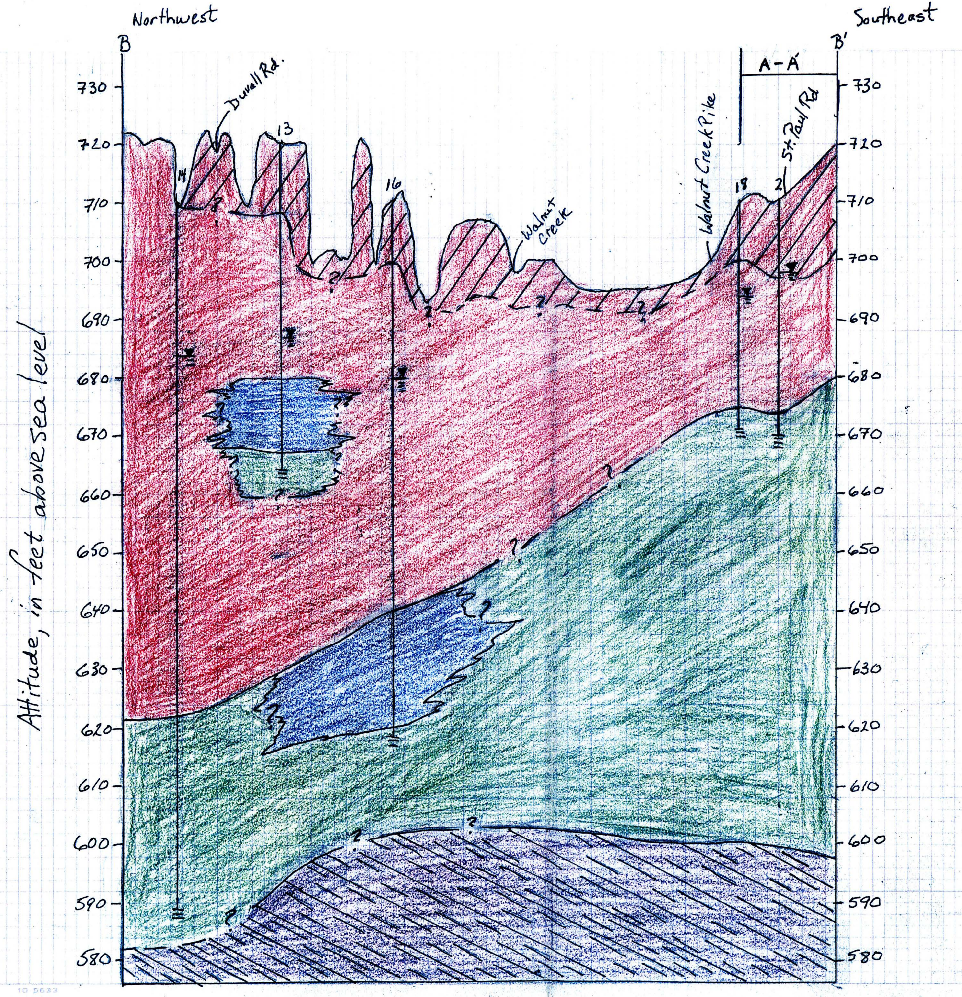
—?— unknown boundary

Bedrock levels from:
Ohio Division of Water
Buried Valley Investigation
No. 1, 1965


Madison Twp. A-A'
A North
A' South
Altitude, in feet above sea level
750
740
730
720
710
700
690
680
670
660
650
640
630
620
610
21
20
Duvall Rd.
A
Walnut Creek
B
C
D E
Walnut Creek Pike
B-B'
St Paul Rd
Vertical Exaggeration: 85X
Scale:
0
0.25
0.50
1 in = 0.25 miles
PLATE III
LITHOLOGIC KEY
oxidized
Confining Layers
clay, silt with minor amounts sand, gravel
Aquifers
sand
sand & gravel
Bedrock
shale
SYMBOLS
water level from driller's log
?
unknown boundary
Bedrock levels from:
Ohio Division of Water
Buried Valley
Investigation
No. 1 1965

Madison Twp.: B-B'

# PLATE IV




## LITHOLOGIC KEY

oxidized

Confining Layers

clay, silt with minor amounts of sand, gravel

Aquifers

sand

sand & gravel

Bedrock

shale

## SYMBOLS

water level from driller's log

—?— unknown boundary

Bedrock levels from Ohio Division of Water Buried Valley Investigation No. 1, 1965

Scale

0 0.25 0.50

1 in = 0.25 mi

Vertical Exaggeration 85 X